Covariances for evaluations based on extensive modelling

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There is an increasing demand from the user community for evaluated nuclear data files which include covariance matrices. At present corresponding evaluated files exist only for a small group of isotopes and are almost exclusively based on experimental data up to 20MeV. The planned extension of the energy range of evaluated nuclear data files to about 200MeV requires extensive use of nuclear models. The determination of the covariance matrix associated with model calculations is still an open question.

In this contribution we present a method for the determination of covariances of integral cross sections for model calculations. The method accounts for three types of uncertainties, i.e. the parameter uncertainties, the numerical implementation errors and the model deficiencies. Thus it provides covariance matrices for phenomenological models as well as for almost parameter free microscopic calculations on the same footing. Emphasis is given to a reliable estimate of covariance contributions due to model failures. Based on a well defined mean model error we construct a covariance matrix which satisfies the essential statistical requirements. The covariance contributions due to parameter uncertainties have been evaluated by the usual statistical procedures. Numerical implementation errors depend on the considered observable and the numerical algorithm and must be considered for each case separately.

We apply this method to determine covariances associated with a phenomenological and a microscopic Optical Model calculation for ^{56}Fe. These covariances are used as a-priori values in a Bayesian update procedure with experimental data in the energy range 20 to 60MeV thus extending the evaluated data file of ^{56}Fe with covariances. Although the two models are quite different, the error bands overlap essentially even in cases of scarce data which is an indication of the reliability of the proposed procedure. Further applications are in progress.

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